

Part EC – The IECC, as Modified by Chapter Comm 63

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For materials with thermal resistivity values less than 4.0, the minimum insulation thickness shall be permitted to be increased in accordance with Equation 5-10.

$$\frac{4.0 \times \text{Table 503.3.3.1 Thickness}}{\text{Actual Resistivity}} = \frac{\text{New Minimum Thickness}}{\text{Thickness}} \quad (\text{Equation 5-10})$$

503.3.3.3 [Comm 63.0503 (2) (b)] Duct and plenum insulation. Duct and plenum insulation shall be provided in accordance with s. Comm 63.0803 (2) (f).

[M] 503.3.3.4 Duct construction. Ductwork shall be constructed and erected in accordance with the *International Mechanical Code*.

503.3.3.4.1 High- and medium-pressure duct systems. High-pressure and medium-pressure ducts shall be leak tested in accordance with the SMACNA *HVAC Air Duct Leakage Test Manual* with the rate of air leakage not to exceed the maximum rate specified in that standard.

503.3.3.4.2 [Comm 63.0503 (2) (c)] Low-pressure duct systems. Low-pressure duct systems shall comply with all of the following:

1. Sections of supply and return ducts not located entirely within the conditioned space, and the unconditioned side of enclosed stud bays or joist cavities or spaces that are used to transport air shall be sealed.
2. Sealing shall be accomplished using welds, gaskets, mastics, mastic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer's instructions.
3. Insulation that provides a continuous air barrier may be used in lieu of sealing metal ducts.
4. Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled as complying with UL 181A.
5. Tapes and mastics used with flexible air ducts shall be listed and labeled as complying with UL 181B.
6. Tapes with rubber-based adhesives may not be used.

Note: Standard duct tape has a rubber-based adhesive and does not comply with the requirements under this section.

Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at static pressures less than 2 inches w.g. (500 Pa) pressure classification.

**TABLE 503.3.3.3
MINIMUM DUCT INSULATION^a**

DUCT LOCATION	COOLING ^b		HEATING ^c	
	Annual cooling degree days	Insulation <i>R</i> -value ^g (h · ft ² · °F)/Btu	Annual heating degree days	Insulation <i>R</i> -value ^g (h · ft ² · °F)/Btu
Exterior of building	Below 500	3.3	Below 1,500	3.3
	500 to 1,150	5.0	1,500 to 4,500	5.0
	1,151 to 2,000	6.5	4,501 to 7,500	6.5
	Above 2,000	8.0	Above 7,500	8.0
In unconditioned spaces ^d				
TD ^e ≤ 15	—	None required	—	None required
40 ≥ TD ^e > 15	—	3.3	—	3.3
TD ^e > 40	—	5.0 ^f	—	5.0 ^f

For SI: 1 foot = 304.8 mm, °C = [(°F)-32] ÷ 1.8, 1 (h · ft² · °F)/Btu = 0.176 (m² · K)/W.

- Insulation *R*-values shown are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and condensation. Where control of condensation is required, additional insulation, vapor retarders, or both, shall be provided to limit vapor transmission and condensation. For ducts that are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of this section.
- Cooling ducts are those designed to convey mechanically cooled air or return ducts in such systems.
- Heating ducts are those designed to convey mechanically heated air or return ducts in such systems.
- Unconditioned spaces include ventilated crawl spaces, ventilated attics, and framed cavities in those floor, wall and ceiling assemblies which (a) separate conditioned space from unconditioned space or outside air, and (b) are uninsulated on the side facing away from conditioned space.
- TD is defined as the temperature difference at design conditions between the space within which the duct is located and the design air temperature in the duct.
- Insulation resistance for runouts to terminal devices less than 10 feet in length is not required to exceed 3.3 ((h·ft² · °F)/Btu).
- Insulation resistance measured on a horizontal plane in accordance with ASTM C 518, at a mean temperature of 75°F at the installed thickness.

503.3.3.4.3 [Comm 63.0503 (2) (d)] Sealing required. High- and medium-pressure ducts shall be sealed in accordance with s. Comm 63.1029 (4).

503.3.3.5 [Comm 63.0503 (2) (e)] Mechanical ventilation. Each mechanical ventilation system (supply or exhaust, or both) shall be equipped with a readily accessible switch or other means for shutoff, or volume reduction and shutoff, when ventilation is not required. Automatic or gravity dampers that close when the system is not operating shall be provided for outdoor air exhausts. Motorized dampers that close when the system is not operating shall be provided on all outdoor air intakes.

503.3.3.6 Transport energy. The air-transport factor for each all-air system shall be not less than 5.5 when calculated in accordance with Equation 5-11. Energy for transfer of air through heat-recovery devices shall not be included in determining the air transport factor.

$$\text{Transport Factor} = \frac{\text{Space Sensible Heat Removal}^a}{\text{Supply} + \text{Return Fan(s) Power Input}^a}$$

(Equation 5-11)

a. Expressed in consistent units, either Btu/h or watts.

For purposes of these calculations, space sensible heat removal is equivalent to the maximum coincident design sensible cooling load of all spaces served for which the system provides cooling. Fan power input is the rate of energy delivered to the fan prime mover.

Air and water, all-water and unitary systems employing chilled, hot, dual-temperature or condenser water-transport systems to space terminals shall not require greater transport energy (including central and terminal fan power and pump power) than an equivalent all-air system providing the same space sensible heat removal and having an air-transport factor of not less than 5.5.

503.3.3.7 [Comm 63.0503 (2) (f)] Balancing. Balancing and documentation of the HVAC system shall conform to the IMC.

SECTION 504 SERVICE WATER HEATING

504.1 Scope. The purpose of this section is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating. Water supplies to ice-making machines and refrigerators shall be taken from a cold-water line of the water distribution system.

504.2 Water heaters, storage tanks and boilers. Water heaters, storage tanks and boilers shall meet the performance criteria set forth in Sections 504.2.1 and 504.2.2.

504.2.1 Performance efficiency. Water heaters and hot water storage tanks shall meet the minimum performance of

water-heating equipment specified in Table 504.2. Where multiple criteria are listed, all criteria shall be met.

Exception: Storage water heaters and hot water storage tanks having more than 140 gallons (530 L) of storage capacity need not meet the standby loss (*SL*) or heat loss (*HL*) requirements of Table 504.2 if the tank surface area is thermally insulated to R-12.5 and if a standing pilot light is not used.

504.2.2 Combination service water-heating/space-heating boilers. Service water-heating equipment shall not be dependent on year-round operation of space-heating boilers; that is, boilers that have as another function winter space heating.

Exceptions:

1. Deleted.
2. For systems where the use of a single heating unit will lead to energy savings, such unit shall be utilized.

504.3 Deleted.

504.3.1 - 504.3.3 Deleted.

504.4 Pump operation. Circulating hot water systems shall be arranged so that the circulation pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

504.5 [Comm 63.504 (2)] Pipe insulation. Pipe insulation shall be provided in accordance with s. Comm 63.1029 (1) and (2).

504.6 Conservation of hot water. Hot water shall be conserved in accordance with Section 504.6.1.

504.6.1 Showers. Shower heads shall have a maximum flow rate of 2.5 gallons per minute (gpm) (0.158 L/s) at a pressure of 80 pounds per square inch (psi) (551 kPa) when tested in accordance with ASME A112.18.1.

**TABLE 504.5
MINIMUM PIPE INSULATION
(thickness in inches)**

SERVICE WATER- HEATING TEMPERATURES (°F)	PIPE SIZES ^a			
	Noncirculating runouts	Circulating mains and runouts		
		Up to 1"	Up to 1.25"	1.5" to 2"
170-180	0.5	1.0	1.5	2.0
140-169	0.5	0.5	1.0	1.5
100-139	0.5	0.5	0.5	1.0

For SI: 1 inch = 25.4 mm, °C = [(°F)-32]/1.8,
1 Btu/h/inch · ft² · °F = 0.144 W/(m · K).

a. Nominal iron pipe size and insulation thickness. Conductivity, *k* ≅ 0.27

504.7 Heat traps. Water heaters with vertical pipe risers shall have a heat trap on both the inlet and outlet of the water heater unless the water heater has an integral heat trap or is part of a circulating system.

TABLE 602.1.1.1(1)
MASS WALL PRESCRIPTIVE BUILDING ENVELOPE REQUIREMENTS

MASS WALL ASSEMBLY R-VALUE^a			
Building Location		Exterior or Integral Insulation	Other Mass Walls
Zone	HDD	Residential Buildings Type A-1 or A-2	Residential Buildings Type A-1 or A-2
1	0-499	R-3.8	R-9.7
2	500-999	R-4.8	R-9.7
3	1,000-1,499	R-4.8	R-9.7
4	1,500-1,999	R-8.1	R-10.8
5	2,000-2,499	R-8.9	R-10.8
6	2,500-2,999	R-8.9	R-10.8
7	3,000-3,499	R-8.9	R-10.8
8	3,500-3,999	R-8.9	R-10.8
9	4,000-4,499	R-8.9	R-10.9
10	4,500-4,999	R-10.4	R-12.3
11	5,000-5,499	R-11.9	R-15.2
12	5,500-5,999	R-11.9	R-15.2
13	6,000-6,499	R-11.9	R-15.2
14	6,500-6,999	R-15.5	R-18.4
15	7,000-8,499	R-15.5	R-18.4
16	8,500-8,999	R-18.4	R-18.4
17	9,000-12,999	R-18.4	R-18.4

a. The sum of the value in Table 602.1.1.1(2) and additional insulation layers.

TABLE 602.1.1.1(2)
MASS ASSEMBLY R-VALUES

ASSEMBLY TYPE	UNGROUTED CELLS, NOT INSULATED	UNGROUTED CELLS INSULATED		
		No grout	Vertical cells grouted at 10' O. C. or greater	Vertical cells grouted at less than 10' O.C.
6" Lightweight concrete block	2.3	5.0	4.5	3.8
6" Medium-weight concrete block	2.1	4.2	3.8	3.2
6" Normal-weight concrete block	1.9	3.3	3.1	2.7
8" Lightweight concrete block	2.6	6.7	5.9	4.8
8" Medium-weight concrete block	2.3	5.3	4.8	4.0
8" Normal-weight concrete block	2.1	4.2	3.8	3.3
12" Lightweight concrete block	2.9	9.1	7.9	6.3
12" Medium-weight concrete block	2.6	7.1	6.4	5.2
12" Normal-weight concrete block	2.3	5.6	5.1	4.3
Brick cavity wall	3.7	6.7	6.2	5.4
Hollow clay brick	2.0	2.7	2.6	2.4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

602.1.3 Opaque doors. Opaque doors in the building envelope shall have a maximum *U*-factor of 0.35. One opaque door shall be exempt from this *U*-factor requirement.

602.1.4 [Comm 63.0602 (1)] Floor. The required *R*-value in Table 602.1 shall apply to all floors.

602.1.5 Basement walls. Where the basement is considered a conditioned space, the basement shall be insulated in accordance with Table 602.1. Where the basement is not considered a conditioned space, either the basement wall or the ceiling(s) separating the basement from conditioned space shall be insulated in accordance with Table 602.1. Where basement walls are required to be insulated, the required *R*-value shall be applied from the top of the basement wall to a depth of 10 feet (3048 mm) below grade or to the top of the basement floor, whichever is less.

602.1.6 Slab-on-grade floors. For slabs with a top edge 12 inches (305 mm) or less below finished grade, the required “Slab perimeter *R*-value and depth” in Table 602.1 shall be applied to the outside of the foundation or the inside of the foundation wall. The insulation shall extend downward from the top of the slab or downward from the top of the slab to the bottom of the slab and then horizontally to the interior or exterior, until the distance listed in Table 602.1 is reached.

Where installed between the exterior wall and the edge of the interior slab, the top edge of the insulation shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Insulation extending horizontally outside of the foundation shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil.

In locations of 500 HDD or greater, *R*-2 shall be added to the “Slab perimeter *R*-value” in Table 602.1 where uninsulated hot water pipes, air distribution ducts, or electric heating cables are installed within or under the slab.

Exception: Slab perimeter insulation is not required for unheated slabs in areas of very heavy termite infestation probability as shown in Figure 502.2(7). Where this exception is used, building envelope compliance shall be demonstrated by (a) using Section 502.2.2 or Chapter 4 with the actual “Slab perimeter *R*-value and depth” in Table 602.1, or (b) using Section 502.2.4.

602.1.7 Crawl space walls. Where the floor above the crawl space is uninsulated, insulation shall be installed on crawl space walls when the crawl space is not vented to outside air. The required “Crawl space wall *R*-value” in Table 602.1 shall be applied inside of the crawl space wall, downward from the sill plate to the exterior finished grade level and then vertically or horizontally or both for 24 inches (610 mm). The exposed earth in all crawl space foundations shall be covered with a continuous vapor retarder having a maximum permeance rating of 1.0 perm (5.72×10^{-8} g/Pa · s · m²), when tested in accordance with ASTM E 96.

602.1.8 Masonry veneer. For exterior foundation insulation, the horizontal portion of the foundation which supports a masonry veneer is not required to be insulated.

602.1.9 Protection. Exposed insulating materials applied to the exterior of foundation walls shall have a rigid, opaque

and weather-resistant protective covering. The protective covering shall extend 6 inches (152 mm) below finished grade level.

602.1.10 Caulking, sealants and gasketing. All joints, seams, penetrations (site-built windows, doors, and skylights), openings between window and door assemblies and their respective jambs and framing, and other sources of air leakage (infiltration and exfiltration) through the building envelope shall be caulked, gasketed, weatherstripped, wrapped, or otherwise sealed to limit uncontrolled air movement.

Comm 63.0602 (2) Additional caulking, sealants and gasketing requirements. When installed in the building envelope, recessed lighting fixtures shall comply with IECC Section 502.1.3.

602.2 Maximum solar heat gain coefficient for fenestration products. In locations with heating degree days (HDD) less than 3,500, the area-weighted-average solar heat gain coefficient (SHGC) for glazed fenestration installed in the building envelope shall not exceed 0.40.

602.3 Fenestration exemption. Up to 1 percent of the total glazing area shall be exempt from the “Glazing *U*-factor” requirement in Table 602.1.

602.4 Replacement fenestration. Where an entire fenestration product, including frame, sash, and glazed portion, is being replaced, the replacement fenestration product shall have a *U*-factor that does not exceed the “Fenestration *U*-factor” requirement in Table 502.2.5 applicable to the climate zone (HDD) where the building is located. The replacement fenestration product(s) must also satisfy the air leakage requirements and SHGC of Sections 601.3.2.2 and 602.2, respectively.

Exception: Replacement skylights shall have a maximum *U*-factor of 0.50 when installed in any location above 1,999 HDD.

SECTION 603 MECHANICAL SYSTEMS

603.1 Heating and air-conditioning equipment and appliances. Heating and air-conditioning equipment and appliances shall comply with the applicable requirements of Section 503.

SECTION 604 SERVICE WATER HEATING

604.1 Water-heating equipment and appliances. Water-heating equipment and appliances shall comply with the applicable requirements of Section 504.

CHAPTER 8

DESIGN BY ACCEPTABLE PRACTICE FOR COMMERCIAL BUILDINGS

SECTION 801 SCOPE

801.1 General. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. Buildings constructed in accordance with this chapter are deemed to comply with this code.

801.2 Application. The requirements in Sections 802, 803, 804 and 805 shall each be satisfied on an individual basis. Where one or more of these sections is not satisfied, compliance for that section(s) shall be demonstrated in accordance with the applicable provisions of ASHRAE/IESNA *Energy Code for Commercial and High-Rise Residential Buildings*.

Exception: Buildings meeting Section 806 provided Sections 802.1.2, 802.3, 803.2.1 or 803.3.1 as applicable, 803.2.2 or 803.3.2 as applicable, 803.2.3 or 803.3.3 as applicable, 803.2.8 or 803.3.6 as applicable, 803.2.9 or 803.3.7 as applicable, 804, 805.2, 805.3, and 805.5 are each satisfied.

SECTION 802 BUILDING ENVELOPE REQUIREMENTS

802.1 General. Walls, roof assemblies, floors, glazing, and slabs on grade which are part of the building envelope for buildings where the window and glazed door area is not greater than 50 percent of the gross area of above-grade walls shall meet the requirements of Sections 802.2.1 through 802.2.8, as applicable. Buildings with more glazing shall meet the applicable provisions of ASHRAE/IESNA *Energy Code for Commercial and High-Rise Residential Buildings*.

Comm 63.0802 (1) Additional building envelope requirements. Glazed structures or glazed portions of buildings used for the production of plant life or for maintaining plant life as the primary purpose of the structure are exempt from the building envelope requirements. When the glazed areas are attached to a building with a different class of construction, these glazed areas shall be separated from the remainder of the building with construction material complying with the building envelope requirements.

802.1.1 Classification of walls. Walls associated with the building envelope shall be classified in accordance with Section 802.1.1.1, 802.1.1.2 or 802.1.1.3.

802.1.1.1 Above-grade walls. Above-grade walls are those walls covered by Section 802.2.1 on the exterior of the building and completely above grade or the above-grade portion of a basement or first-story wall that is more than 15 percent above grade.

802.1.1.2 Below-grade walls. Below-grade walls covered by Section 802.2.8 are basement or first-story walls associated with the exterior of the building that are at least 85 percent below grade.

802.1.1.3 Interior walls. Interior walls covered by Section 802.2.9 are those walls not on the exterior of the building and that separate conditioned and unconditioned space.

802.1.2 [Comm 63.0802 (2)] Moisture control.

- (a) **General.** Except as specified in par. (b), vapor retarders shall be provided on all warm-in-winter sides of frame walls, floors and ceilings. The vapor retarder shall have a maximum permance rating of 1.0 perm when tested in accordance with Procedure A of the ASTM E 96, Standard Test Methods for Water Vapor Transmission of Materials.
- (b) **Other approved means.** Where other approved means to avoid condensation in unventilated framed wall, floor, roof and ceiling cavities are provided.

802.2 Criteria. The building envelope components shall meet each of the applicable requirements in Tables 802.2(1), 802.2(2), 802.2(3) and 802.2(4) based on the percentage of wall that is glazed. The percentage of wall that is glazed shall be determined by dividing the aggregate area of rough openings for glazing (windows and glazed doors) in all the above-grade walls associated with the building envelope by the total gross area of all above-grade exterior walls that are a part of the building envelope. In buildings with multiple types of building envelope construction, each building envelope construction type shall be evaluated separately. Where Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4) does not list a particular construction type, the applicable provisions of ASHRAE/IESNA *Energy Code for Commercial and High-Rise Residential Buildings* shall be used in lieu of Section 802.

802.2.1 Above-grade walls. The minimum thermal resistance (*R*-value) of the insulating material(s) installed in the wall cavity between the framing members and continuously on the walls shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4), based on framing type and construction materials used in the wall assembly. Where both cavity and continuous insulation values are provided in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4), both requirements shall be met. Concrete masonry units (CMU) at least 8-inch (203 mm) nominal thickness with essentially equal amounts of mass on either side of the insulation layer are considered as having integral insulation, however, the thermal resistance of that insulation shall not be considered when determining compliance with Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4). "Other masonry walls" shall include walls weighing at least 35 lb/ft² (170 kg/m²) of wall surface area and do not include CMUs less than 8 inches (203 mm) nominal thickness.

Tables 802.2(5) through (32) and 802.2(36) through (37). Deleted.

TABLE 802.2(1)
BUILDING ENVELOPE REQUIREMENTS^a through ^e
WINDOW AND GLAZED DOOR AREA 10 PERCENT OR LESS OF ABOVE-GRADE WALL AREA

ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i> -factor)			
Slab or below-grade wall (<i>R</i> -value)			
Windows and glass doors	SHGC	<i>U</i> -factor	
PF < 0.25			
0.25 ≤ PF < 0.50			
PF ≥ 0.50			
Roof assemblies (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Metal purlin with thermal block			
Metal purlin without thermal block			
Floors over outdoor air or unconditioned space (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Above-grade walls (<i>R</i> -value)	No framing	Metal framing	Wood framing
Framed <i>R</i> -value cavity	NA		
<i>R</i> -value continuous	NA		
CMU, ≥ 8 in, with integral insulation <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			
Other masonry walls <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			

For SI: 1 inch = 25.4 mm.

- a. Values shall be determined from Tables 802.2(5) through 802.2(37) using the climate zones specified in Table 302.1. (Note: The tables begin on page EC-54)
- b. "NA" indicates the condition is not applicable.
- c. An *R*-value of zero indicates no insulation is required.
- d. "Any" indicates any available product will comply.
- e. "X" indicates no complying option exists for this condition.

TABLE 802.2(2)
BUILDING ENVELOPE REQUIREMENTS^{a through e}
WINDOW AND GLAZED DOOR AREA OVER 10 PERCENT BUT NOT GREATER THAN 25 PERCENT OF ABOVE-GRADE WALL AREA

ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i> -factor)			
Slab or below-grade wall (<i>R</i> -value)			
Windows and glass doors	SHGC	<i>U</i> -factor	
PF < 0.25			
0.25 ≤ PF < 0.50			
PF ≥ 0.50			
Roof assemblies (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Metal purlin with thermal block			
Metal purlin without thermal block			
Floors over outdoor air or unconditioned space (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Above-grade walls (<i>R</i> -value)	No framing	Metal framing	Wood framing
Framed <i>R</i> -value cavity	NA		
<i>R</i> -value continuous	NA		
CMU, ≥ 8 in, with integral insulation <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			
Other masonry walls <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			

For SI: 1 inch = 25.4 mm.

- a. Values shall be determined from Tables 802.2(5) through 802.2(37) using the climate zones specified in Table 302.1. (Note: The tables begin on page EC-54)
- b. "NA" indicates the condition is not applicable.
- c. An *R*-value of zero indicates no insulation is required.
- d. "Any" indicates any available product will comply.
- e. "X" indicates no complying option exists for this condition.

TABLE 802.2(3)
BUILDING ENVELOPE REQUIREMENTS^a through ^e
WINDOW AND GLAZED DOOR AREA OVER 25 PERCENT BUT NOT GREATER THAN 40 PERCENT OF ABOVE-GRADE WALL AREA

ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i> -factor)			
Slab or below-grade wall (<i>R</i> -value)			
Windows and glass doors	SHGC	<i>U</i> -factor	
PF < 0.25			
0.25 ≤ PF < 0.50			
PF ≥ 0.50			
Roof assemblies (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Metal purlin with thermal block			
Metal purlin without thermal block			
Floors over outdoor air or unconditioned space (<i>R</i> -value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Above-grade walls (<i>R</i> -value)	No framing	Metal framing	Wood framing
Framed <i>R</i> -value cavity	NA		
<i>R</i> -value continuous	NA		
CMU, ≥ 8 in, with integral insulation <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			
Other masonry walls <i>R</i> -value cavity	NA		
<i>R</i> -value continuous			

For SI: 1 inch = 25.4 mm.

- a. Values shall be determined from Tables 802.2(5) through 802.2(37) using the climate zones specified in Table 302.1. (Note: The tables begin on page EC-54)
- b. "NA" indicates the condition is not applicable.
- c. An *R*-value of zero indicates no insulation is required.
- d. "Any" indicates any available product will comply.
- e. "X" indicates no complying option exists for this condition.

TABLE 802.2(4)
BUILDING ENVELOPE REQUIREMENTS^a through ^e
WINDOW AND GLAZED DOOR AREA OVER 40 PERCENT BUT NOT GREATER THAN 50 PERCENT OF ABOVE-GRADE WALL AREA

ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i>-factor)			
Slab or below-grade wall (<i>R</i>-value)			
Windows and glass doors	SHGC	<i>U</i>-factor	
PF < 0.25			
0.25 ≤ PF < 0.50			
PF ≥ 0.50			
Roof assemblies (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Metal purlin with thermal block			
Metal purlin without thermal block			
Floors over outdoor air or unconditioned space (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss			
Metal joist/truss			
Concrete slab or deck			
Above-grade walls (<i>R</i>-value)	No framing	Metal framing	Wood framing
Framed			
<i>R</i> -value cavity	NA		
<i>R</i> -value continuous	NA		
CMU, ≥ 8 in, with integral insulation			
<i>R</i> -value cavity	NA		
<i>R</i> -value continuous			
Other masonry walls			
<i>R</i> -value cavity	NA		
<i>R</i> -value continuous			

For SI: 1 inch = 25.4 mm.

- a. Values shall be determined from Tables 802.2(5) through 802.2(37) using the climate zones specified in Table 302.1. (Note: The tables begin on page EC-54)
- b. "NA" indicates the condition is not applicable.
- c. An *R*-value of zero indicates no insulation is required.
- d. "Any" indicates any available product will comply.
- e. "X" indicates no complying option exists for this condition.

TABLE 802.2(33)
BUILDING ENVELOPE REQUIREMENTS^{a through e} - CLIMATE ZONE 15

WINDOW AND GLAZED DOOR AREA 10 PERCENT OR LESS OF ABOVE-GRADE WALL AREA			
ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i>-factor)	0.6		
Slab or below-grade wall (<i>R</i>-value)	R-0		
Windows and glass doors	SHGC	<i>U</i>-factor	
PF < 0.25	Any	0.7	
0.25 ≤ PF < 0.50	Any	0.7	
PF ≥ 0.50	Any	0.7	
Roof assemblies (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss	R-25	R-19	
Metal joist/truss	R-25	R-20	
Concrete slab or deck	NA	R-19	
Metal purlin with thermal block	R-30	R-20	
Metal purlin without thermal block	X	R-20	
Floors over outdoor air or unconditioned space (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss	R-25	R-22	
Metal joist/truss	R-30	R-23	
Concrete slab or deck	NA	R-22	
Above-grade walls (<i>R</i>-value)	No framing	Metal framing	Wood framing
Framed			
<i>R</i> -value cavity	NA	R-13	R-11
<i>R</i> -value continuous	NA	R-3	R-0
CMU, ≥ 8 in, with integral insulation			
<i>R</i> -value cavity	NA	R-11	R-11
<i>R</i> -value continuous	R-5	R-0	R-0
Other masonry walls			
<i>R</i> -value cavity	NA	R-11	R-11
<i>R</i> -value continuous	R-5	R-0	R-0
WINDOW AND GLAZED DOOR AREA OVER 10 PERCENT BUT NOT GREATER THAN 25 PERCENT OF ABOVE-GRADE WALL AREA			
ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i>-factor)	0.6		
Slab or below-grade wall (<i>R</i>-value)	R-8		
Windows and glass doors	SHGC	<i>U</i>-factor	
PF < 0.25	0.5	0.5	
0.25 ≤ PF < 0.50	0.6	0.5	
PF ≥ 0.50	0.7	0.5	
Roof assemblies (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss	R-25	R-19	
Metal joist/truss	R-25	R-20	
Concrete slab or deck	NA	R-19	
Metal purlin with thermal block	R-30	R-20	
Metal purlin without thermal block	X	R-20	
Floors over outdoor air or unconditioned space (<i>R</i>-value)	Insulation between framing	Continuous insulation	
All-wood joist/truss	R-25	R-22	
Metal joist/truss	R-30	R-23	
Concrete slab or deck	NA	R-22	
Above-grade walls (<i>R</i>-value)	No framing	Metal framing	Wood framing
Framed			
<i>R</i> -value cavity	NA	R-13	R-11
<i>R</i> -value continuous	NA	R-3	R-0
CMU, ≥ 8 in, with integral insulation			
<i>R</i> -value cavity	NA	R-11	R-11
<i>R</i> -value continuous	R-5	R-0	R-0
Other masonry walls			
<i>R</i> -value cavity	NA	R-11	R-11
<i>R</i> -value continuous	R-5	R-0	R-0

(continued)

TABLE 802.2(35)—continued
BUILDING ENVELOPE REQUIREMENTS^b through ^f - CLIMATE ZONE 17

WINDOW AND GLAZED DOOR AREA OVER 25 PERCENT BUT NOT GREATER THAN 40 PERCENT OF ABOVE-GRADE WALL AREA			
ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i> -factor)	0.6		
Slab or below-grade wall (<i>R</i> -value)	R-8		
Windows and glass doors	SHGC ^a	<i>U</i> -factor	
	PF < 0.25	0.7	0.4
	0.25 ≤ PF < 0.50	Any	0.4
	PF ≥ 0.50	Any	0.4
Roof assemblies (<i>R</i> -value)	Insulation between framing	Continuous insulation	
	All-wood joist/truss	R-30	R-23
	Metal joist/truss	R-30	R-24
	Concrete slab or deck	NA	R-23
	Metal purlin with thermal block	X	R-24
	Metal purlin without thermal block	X	R-24
Floors over outdoor air or unconditioned space (<i>R</i> -value)	Insulation between framing	Continuous insulation	
	All-wood joist/truss	R-25	R-22
	Metal joist/truss	R-30	R-23
	Concrete slab or deck	NA	R-22
Above-grade walls (<i>R</i> -value)	No framing	Metal framing	Wood framing
	Framed		
	<i>R</i> -value cavity	NA	R-13
	<i>R</i> -value continuous	NA	R-3
	CMU, ≥ 8 in, with integral insulation		
	<i>R</i> -value cavity	R-13	R-13
	<i>R</i> -value continuous	R-10	R-3
	Other masonry walls		
	<i>R</i> -value cavity	NA	R-13
	<i>R</i> -value continuous	R-10	R-3
WINDOW AND GLAZED DOOR AREA OVER 40 PERCENT BUT NOT GREATER THAN 50 PERCENT OF ABOVE-GRADE WALL AREA			
ELEMENT	CONDITION/VALUE		
Skylights (<i>U</i> -factor)	0.6		
Slab or below-grade wall (<i>R</i> -value)	R-8		
Windows and glass doors	SHGC	<i>U</i> -factor	
	PF < 0.25	0.4	0.4
	0.25 ≤ PF < 0.50	0.5	0.4
	PF ≥ 0.50	0.7	0.4
Roof assemblies (<i>R</i> -value)	Insulation between framing	Continuous insulation	
	All-wood joist/truss	R-30	R-23
	Metal joist/truss	R-30	R-24
	Concrete slab or deck	NA	R-23
	Metal purlin with thermal block	R-38	R-24
	Metal purlin without thermal block	X	R-24
Floors over outdoor air or unconditioned space (<i>R</i> -value)	Insulation between framing	Continuous insulation	
	All-wood joist/truss	R-25	R-22
	Metal joist/truss	R-30	R-23
	Concrete slab or deck	NA	R-22
Above-grade walls (<i>R</i> -value)	No framing	Metal framing	Wood framing
	Framed		
	<i>R</i> -value cavity	NA	R-13
	<i>R</i> -value continuous	NA	R-14
	CMU, ≥ 8 in, with integral insulation		
	<i>R</i> -value cavity	R-13	R-13
	<i>R</i> -value continuous	R-14	R-7
	Other masonry walls		
	<i>R</i> -value cavity	NA	R-13
	<i>R</i> -value continuous	R-14	R-7

For SI: 1 inch = 25.4 mm.

a. For buildings over three stories in height, the maximum SHGC shall be 0.60.

b. Values from Tables 802.2(5) through 802.2(37) shall be used for the purpose of the completion of Tables 802.2(1) through 802.2(4), as applicable based on window and glazed door area.

c. “NA” indicates the condition is not applicable.

d. An *R*-value of zero indicates no insulation is required.

e. “Any” indicates any available product will comply.

f. “X” indicates no complying option exists for this condition.

802.2.2 Nonglazed doors. Nonglazed doors shall meet the applicable requirements for windows and glazed doors and be considered as part of the gross area of above-grade walls that are part of the building envelope.

802.2.3 Windows and glass doors. The maximum solar heat gain coefficient (SHGC) and thermal transmittance (*U*-factor) of window assemblies and glass doors located in the building envelope shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4), based on the window projection factor.

The window projection factor shall be determined in accordance with Equation 8-1.

$$PF = A/B \quad (\text{Equation 8-1})$$

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the furthest continuous extremity of any overhang, eave, or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave, or permanently attached shading device.

Where different windows or glass doors have different *PF* values, they shall each be evaluated separately, or an area-weighted *PF* value shall be calculated and used for all windows and glass doors.

802.2.4 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4), based on construction materials used in the roof assembly.

Comm 63.0802 (3) Additional roof assembly requirements. The thermal transmittance value for ceilings next to unconditioned spaces shall comply with s. Comm 63.1015 (5).

802.2.5 Skylights. Skylights located in the building envelope shall be limited to 3 percent of the gross roof assembly area and shall have a maximum thermal transmittance (*U*-factor) of the skylight assembly as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4).

802.2.6 Floors over outdoor air or unconditioned space. The minimum thermal resistance (*R*-value) of the insulating material installed either between the floor framing or continuously on the floor assembly shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4) based on construction materials used in the floor assembly.

802.2.7 Slabs on grade. The minimum thermal resistance (*R*-value) of the insulation around the perimeter of the slab floor shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4). The insulation shall be placed on the outside of the foundation or on the inside of a foundation wall. The insulation shall extend downward from the top of the slab for a minimum of 48 inches (1219 mm) or downward to at least the bottom of the slab and then horizontally

to the interior or exterior for a minimum total distance of 48 inches (1219 mm).

802.2.8 Below-grade walls. The minimum thermal resistance (*R*-value) of the insulating material installed in, or continuously on, the below-grade walls shall be as specified in Table 802.2(1), 802.2(2), 802.2(3) or 802.2(4) and shall extend to a depth of 10 feet (3048 mm) below the outside finish ground level, or to the level of the floor, whichever is less.

802.2.9 Interior walls. The minimum thermal resistance (*R*-value) of the insulating material installed in the wall cavity or continuously on the interior walls shall be as specified in Table 802.2(1) for above-grade walls, regardless of glazing area, based on framing type and construction materials used in the wall assembly.

802.3 Air leakage. The requirements for air leakage shall be as specified in Sections 802.3.1 and 802.3.2.

802.3.1 Window, door, and curtain wall assemblies. Window, sliding or swinging doors and curtain wall assemblies that are part of the building envelope shall be tested and listed as meeting AAMA/WDMA 101/I.S.2.

Exception: Site-constructed windows and doors that are weatherstripped or sealed in accordance with Section 802.3.2.

Commercial entrance doors shall have a maximum air infiltration rate of 1.75 cubic feet per minute (cfm)/ft² (32.0 m³/h · m²) of door area when tested in accordance with ASTM E 283.

802.3.2 Sealing of the building envelope. Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

Comm 63.0802 (4) Additional sealing of the building envelope requirements. When installed in the building envelope, recessed lighting fixtures shall comply with IECC Section 502.1.3.

SECTION 803 BUILDING MECHANICAL SYSTEMS

803.1 General. This section covers the design and construction of mechanical systems and equipment serving the building heating, cooling, or ventilating needs.

Comm 63.0803 (1) Additional building mechanical systems requirements. Electrical motors shall comply with s. Comm 63.1032.

803.2 Simple HVAC systems and equipment. This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 803.2.2(1) through 803.2.2(5), each serving one zone and controlled by a single thermostat in the

TABLE 803.2.6
MINIMUM EQUIPMENT EFFICIENCY ECONOMIZER EXCEPTION

TOTAL COOLING CAPACITY OF EQUIPMENT	BUILDING LOCATION		
	Zones 6a, 9a, 10a, 11a, 12a, 12b, 13a, 13b, 14a, 14b, 15-19	Zones 3a, 3b, 4a, 7a, 8, 9b, 10b, 11b	Zones 4b, 5a, 5b, 6b, 7b
90,000 Btu/h to 134,999 Btu/h	NA	11.4 EER	10.4 EER
135,000 Btu/h to 759,999 Btu/h	NA	10.9 EER	9.9 EER
760,000 Btu/h or more	NA	10.5 EER	9.6 EER

For SI: °C = [(°F)-32]/1.8, 1 Btu/h = 0.2931 W.

NA = Not Applicable.

3. Joints, longitudinal and transverse seams, and connections. Joints, longitudinal and transverse seams, and connections in ductwork shall be sealed in accordance with s. Comm 63.1029 (4).

803.2.9 Piping insulation. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Section 803.3.7.

803.3 Complex HVAC systems and equipment. This section applies to buildings served by HVAC equipment and systems not covered in Section 803.2.

803.3.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with Section 803.2.1.

803.3.1.1 [Comm 63.0803 (3) (a)] Equipment and system sizing. Heating and cooling equipment and system capacity shall be sized to provide the minimum space and system loads calculated in accordance with IECC Section 803.2.1.

Exceptions:

1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating.
2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that have the capability to sequence the operation of each unit based on load.

803.3.2 HVAC equipment performance requirements. Equipment shall meet the minimum efficiency requirements of Tables 803.3.2(1) through 803.3.2(3) and Table 803.2.2(5), when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through data furnished by the manufacturer or through certification under an approved certification program. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor

coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrate the combined efficiency of the specified components meets the requirements herein.

Where unitary or prepackaged equipment is used in a complex HVAC system and is not covered by Section 803.3.2, the equipment shall meet the applicable requirements of Section 803.2.2.

803.3.3 HVAC system controls. Each heating and cooling system shall be provided with thermostatic controls as required in Sections 803.3.3.1 through 803.3.3.5.

803.3.3.1 Thermostatic controls. The supply of heating and cooling energy to each zone shall be controlled by individual thermostatic controls capable of responding to temperature within the zone. Where humidification or dehumidification or both is provided, at least one humidity control device shall be provided for each humidity control system

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses or gains or both serving one or more perimeter zones also served by an interior system provided:

1. The perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation (within +/- 45°) for more than 50 contiguous feet (15.2 m) and,
2. The perimeter system heating and cooling supply is controlled by a thermostat(s) located within the zone(s) served by the system.

803.3.3.1.1 Heat pump supplementary heat. Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation when the heat pump can meet the heating load.

803.3.3.2 Set point overlap restriction. Where used to control both heating and cooling, zone thermostatic controls shall provide a temperature range or deadband of at

TABLE 803.3.2(1)
CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^a	TEST PROCEDURE
Condensing units, air cooled	≥ 135,000 Btu/h	—	9.9 EER 11.0 IPLV	Note b
Condensing units, water or evaporatively cooled	≥ 135,000 Btu/h	—	12.9 EER 12.9 IPLV	

For SI: 1 Btu/h = 0.2931 W.

a. IPLVs are only applicable to equipment with capacity modulation.

b. See ARI 365.

TABLE 803.3.2(2)
WATER CHILLING PACKAGES, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY ^a	TEST PROCEDURE
Air cooled, with condenser, electrically operated	< 150 tons	2.70 COP 2.80 IPLV	Note c
	≥ 150 tons	2.50 COP 2.50 IPLV	
Air cooled, without condenser, electrically operated	All capacities	3.10 COP 3.20 IPLV	
Water cooled, electrically operated	< 150 tons	3.80 COP 3.90 IPLV	
	≥ 150 tons and < 300 tons	4.20 COP 4.50 IPLV	
	≥ 300 tons	5.20 COP ^b 5.30 IPLV	

For SI: 1 Btu/h = 0.2931 W, 1 ton refrigeration = 12,000 Btu/h.

a. Equipment must comply with all efficiencies.

b. These requirements are reduced to 4.70 COP and 4.80 IPLV where R-22 is used or where refrigerants with an ozone depletion factor less than that for R-22 are used.

c. See ARI 550 or 590 as applicable.

TABLE 803.3.2(3)
WARM AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION ^a	MINIMUM THERMAL EFFICIENCY	TEST PROCEDURE
Warm air duct furnaces, gas-fired	All capacities	Maximum capacity Minimum capacity	78% E_t 75% E_t	Note b
Warm air unit heaters, gas-fired	All capacities	Maximum capacity Minimum capacity	78% E_t 74% E_t	Note c
Warm air unit heaters, oil-fired	All capacities	Maximum capacity Minimum capacity	81% E_t 81% E_t	Note d

a. Minimum and maximum ratings as provided for and allowed by the unit's controls. Equipment must comply with all efficiencies when multiple efficiencies are indicated.

b. See ANSI Z83.9.

c. See ANSI Z83.8.

d. See UL 731.

CHAPTER 9 REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in Section 107.

AAMA	American Architectural Manufacturers Association 1827 Walden Office Square Suite 104 Schaumburg, IL 60173-4628	
	Standard reference number	Referenced in code section number
	Title	
101/I.S.2—97	Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors	Table 502.1.4.1, 601.3.2.2, 802.3.1

ANSI	American National Standards Institute 25 West 43rd Street Fourth Floor New York, NY 10036	
	Standard reference number	Referenced in code section number
	Title	
Z21.10.3—98	Gas Water Heaters, Volume III, Circulating Tank, Instantaneous and Large Automatic Storage-Type Heaters	Table 504.2
Z21.13—91	Gas-Fired Low-Pressure Steam and Hot Water Boilers—with 1993 and 1994 Addenda	Table 803.2.2(5)
Z21.47—93	Gas-Fired Central Furnaces (Except Direct Vent and Separated Combustion System Furnaces) — with Addendum Z21.47a-1995 and Z21.47b-1997.	Table 803.2.2(4)
Z21.56—98	Gas-Fired Pool Heaters	Table 504.2
Z83.8—96	Gas-Fired Duct Furnaces—with Addendum Z83.8a-1997	Table 803.2.2(4), Table 803.3.2(3)
Z83.9—96	Gas Unit Heaters.	Table 803.2.2(4), Table 803.3.2(3)

ARI	Air Conditioning and Refrigeration Institute 4301 North Fairfax Drive Suite 425 Arlington, VA 22203	
	Standard reference number	Referenced in code section number
	Title	
210/240—94	Unitary Air-Conditioning and Air-Source Heat Pump Equipment.	Table 503.2, Table 803.2.2(1), Table 803.2.2(2)
320—93	Water Source Heat Pumps	Table 803.2.2(2)
325—93	Ground Water Source Heat Pumps	Table 803.2.2(2)
340/360—93	Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.	Table 803.2.2(1), Table 803.2.2(2)
365—94	Commercial and Industrial Unitary Air-Conditioning Condensing Units	Table 803.3.2(1)
310/380—93	Standard for Packaged Terminal Air-Conditioners and Heat Pumps.	202, Table 803.2.2(3)
550/590—98	Water Chilling Packages Using the Vapor Compression Cycle.	Table 803.3.2(2)

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1791 Tullie Circle, NE Atlanta, GA 30329-2305	
	Standard reference number	Referenced in code section number
	Title	
55—92	Thermal Environmental Conditions for Human Occupancy	202
62—89	Ventilation for Acceptable Indoor Air Quality.	202
90.1—89	Energy Efficient Design of New Buildings, Except Low Rise Residential Buildings	63.1016 Note, 63.1020

REFERENCED STANDARDS

ASHRAE—continued

136—93	A Method of Determining Air Change Rates in Detached Dwellings	402.1.3.10
ASHRAE/IESNA—93	Energy Code for Commercial and High-Rise Residential Buildings — Based on ASHRAE/IES 90.1-1989—with Revisions thru October 7, 1997 including Errata and Addendum 90.1c-1993	503.1, 801.2, 802.1, 802.2
ASHRAE—97	Handbook of Fundamentals	Table 302.1, 402.3.2, 502.2.1.1.2, 502.2.2, 503.3.1, 803.2.1
ASHRAE—87	HVAC Systems and Applications Handbook	504.2.2

ASME

American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Standard reference number	Title	Referenced in code section number
A112.18.1M—96	Plumbing Fixture Fittings	504.6.1

ASTM

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2859

Standard reference number	Title	Referenced in code section number
C 236—93	Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box	602.1.1.1
C 177—85	Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-hot-plate Apparatus	63.1018(2)(a)
C 335—84	Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation	63.1018(2)(a)
C 518—98	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	Table 503.3.3.3
C 976—96 ^{e1}	Standard Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box	602.1.1.1
D 4099—95	Standard Specification for Poly (Vinyl Chloride) PVC Prime Windows/Sliding Glass Doors	Table 502.1.4.1
E 96—95	Standard Test Methods for Water Vapor Transmission of Materials	502.1.1, 602.1.7, 802.1.2
E 283—91	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen	502.1.3, Table 502.1.4.1, 802.3.1
E 779—92 ^{e1}	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization	402.1.3.10

DOE

U.S. Department of Energy
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402-9325

Standard reference number	Title	Referenced in code section number
10 CFR; Part 430, Subpart B, Appendix E—98	Uniform Test Method for Measuring the Energy Consumption of Water Heaters	Table 504.2, Table 803.2.2(4)
10 CFR; Part 430, Subpart B, Appendix N—98	Uniform Test Method for Measuring the Energy Consumption of Furnaces	Table 503.2, Table 803.2.2(5)
10 CFR; Part 430, Subpart B, Test Procedures—98	Energy Conservation Program for Consumer Products	202
DOE —88	DOE Building Foundation Design Handbook	Table 502.2, 502.2.1.5, 502.2.3.5
DOE—Current Calendar Year	DOE State-Average Energy Prices	806.2.3

HI

Hydronics Institute
35 Russo Place
P.O. Box 218
Berkley Heights, NJ 07922

Standard reference number	Title	Referenced in code section number
HI HBS 86—89	Heating Boiler Standard 86 - Testing and Rating Standard for Heating Boilers, 6th Ed.	Table 803.2.2(5)